EVALUATION OF ERTS-1 DATA APPLICATIONS TO GEOLOGIC MAPPING, STRUCTURAL ANALYSIS AND MINERAL RESOURCE INVENTORY OF SOUTH AMERICA WITH SPECIAL EMPHASIS ON THE ANDES MOUNTAIN REGION

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2) A paper describing the results mentioned above has been written and submitted to the COSPAR Meeting to be held in late June 1974 in Sao Paulo, Brazil. See references.

3) The P.I. has been asked by the International Union of Geological Sciences (IUGS) to prepare and discuss with attendees of COSPAR the establishment of a Committee on Remote Sensing within IUGS. A draft proposal has been assembled and will soon be distributed to geologists intending to be present at the COSPAR meeting.

4) Techniques developed in this South American experiment are now being applied to comprehensive studies of the mosaic of the United States compiled by the USDA Soil Conservation Service. The band 5 black and white mosaic of the U.S.A. at the 1:5,000,000 scale was analyzed in two days of concentrated effort. Several major linear and curvilinear features have been defined that have not been previously known. Some, however, have been suspected and described previously in the literature. All are being compared with existing geologic and geophysical information. A large circular feature (70 km in diameter) in southern Mississippi has been found to correlate with a known large gravity anomaly. Part of the structure has produced oil and gas. A linear feature extending from central Florida northwestward across the southern tip of the Appalachians into the region of New Madrid, Missouri, may have played some part in the devastating earthquake of 1811. A large circular feature (200 km diameter) has been found to underlie the coal basin of southern Illinois.

A major linear feature has been found to extend from the western shore of Lake Superior and Duluth, Minnesota, southwestward across the Great Plains and through the Rocky Mountains, south of Denver, into Arizona. Another roughly parallels it from the Northern Great Plains through Yellowstone Park, the Snake River Plains, northern Nevada and into the San Francisco Bay area. Major curvilinear features are seen associated with the southern edge of the volcanic region of Oregon and Idaho and the southern part of the Basin and Range in Nevada and California. These possible structures are tentatively believed to be surface expressions of deep-seated crustal anomalies that have persisted through geologic time.

5) More detailed analysis of the SCS Band 7 mosaics at a scale of 1:1,000,000 are also underway by three investigators. The western U. S. is nearly completed. Hopefully the job will be done by June 30, 1974. The interpretations will then be compared to each other to develop relative confidence maps which, in turn, will be sent to local USGS geologists for evaluation with field evidence and published maps. Hopefully these maps will also be used in developing plans for future work in the fields of energy and mineral resource exploration.

6) A paper describing the results mentioned above is in preparation for presentation at the American Institute of Mining and Petroleum Engineers in Acapulco, Mexico, in September 1974. See references.

e. Discussion of significant scientific results and their relationship to practical applications or operational problems (Abstract):

1) The La Paz Mosaic and its attendant overlays (lineation map, mine location map, metallogenic map and seismic risk map) serve as a model for geologic studies elsewhere in the world. The principal investigator and two other USGS geologists are now involved with mapping the conterminous states at scales of 1:5,000,000 and 1:1,000,000. The 1:5,000,000 Band 5 mosaic was completed in 2 days of analysis. The 1:1,000,000 Band 7 sheets are being completed at the rate of one per day. Comparison of the preliminary results of the three investigators shows a high correlation of linear and curvilinear features. Comparison with magnetic and gravity data indicates that many features being mapped are deep seated structures that have been active through long periods of geologic time, perhaps dating back to the Precambrian period.

2) A detailed analysis of E-1243-14013 (black and white, Band 6) of the El Salvador mining district has been completed by Alvaro Tobar, Gabriel Pérez R., and Agustin Gutierrez of the Instituto de Investigaciones Geologicas de Chile. The interpretation is extremely detailed showing a complex pattern of linear features and bedrock outcrop patterns. This is the first product from ERTS to be provided by Chile and shows a high degree of expertise in image interpretation. The Chileans are enthusiastic about their results and are anxious to map the entire country using ERTS.

f. A listing of published articles and/or papers, preprints, in-house reports; abstracts of talks, that were released during the reporting period:

Carter, William D. (in press): ERTS-1: A key ingredient to Mineral and Energy Resource Exploration: Abstract for presentation at the AIME/SME Fall Meeting, September 23-25, 1974, Acapulco, Mexico. (Attachment A)

Carter, William D., ERTS-1: Its potential in estimating population: A talk presented May 10, 1974, to The Population Council, New York, New York.

g. Recommendations concerning practical changes in operations, additional investigative effort, correlation of effort and results as related to a maximum utilization of the ERTS system.

No recommendations at this time.

h. A listing by date of any changes in Standing Order Forms:

None.

i. ERTS Image Descriptor Forms:

None.

j. Listing by date of any changed Data Request Forms submitted to Goddard Space Flight Center/NDPF during the reporting period:

None.

k. Status of Data Collection Platforms:

Not Applicable.

Type I Progress Report - ERTS-1 (Period: 1 March 1974 - 30 April 1974)

a. Title: Structural Geology and Mineral Resource Inventory of South America, with Emphasis on the Andes Mountains
ERTS-A Proposal No. SR 189

b. GSFC ID No. of P.I.: IN-012
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c. Statement and explanation of any problems that are impeding the progress of the investigation:

A heavy workload within the Topographic Division throughout the U.S.A. is making it difficult to find a place where compilation of the next two 4 x 6 degree mosaics (Area 9 - Copiapo, Chile, and Area 10 - Tucuman, Argentina) can be undertaken. Unless an alternative group can be found, the work will have to be deferred until FY 75. This will delay completion of the final report for perhaps 1 to 2 months. Alternative USGS offices now being considered are the Denver Federal Center, Colorado, and Rolla, Missouri, and the Center for Astrogeology, Flagstaff, Arizona. If these centers are unable to undertake the work a commercial firm will be sought.

d. Discussion of the accomplishments during the reporting period and those planned for the next reporting period:

1) Much of the reporting period was devoted to refining the work done in Area 7 - La Paz (16-20°S. and 66-72°W.). The structural analysis has been completed and sent to coinvestigators in Peru, Bolivia and Chile for evaluation. A relative confidence map has been compiled which shows the correlation of the interpretation with published maps (in red) and with other interpretations (in green). The correlation is excellent (80-90%) for the areas mutually covered and the confidence level, therefore, is high. In addition a mine and mineral resource map has been compiled from published sources. Dr. Brockmann has recently submitted an updated mineral resource map of Bolivia that has been added to the existing compilation and enabled the P.I. to develop a new metallogenic map of the area. A seismic risk map showing the location of epicenters of earthquakes having a magnitude of 5 or greater has also been compiled and correlates well with the most obvious and recent linear systems of the western cordillera of the Andes.

Attachment #6

ERTS-1 Data: A Key Ingredient to Mineral and Energy Resource Exploration

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ABSTRACT

The Earth Resources Technology Satellite (ERTS-1), an experimental satellite launched by NASA on July 23, 1972, has acquired approximately 100,000 multispectral images of the earth in 2 years of operation. While the data have application to many disciplines, it is of special interest and has operational use to scientists and engineers involved in supplying the burgeoning demands for mineral and energy raw materials.

Small-scale mosaics compiled of large areas of North and South America are providing new data that will aid in refining theories of plate tectonics and metallogenesis, and contribute significantly to the selection of new exploration targets. For example, a mosaic of the conterminous United States compiled originally by U.S. Department of Agriculture Soil Conservation Service at a scale of 1:1,000,000 and reduced to 1:5,000,000 permitted the definition of major linear, curvilinear, and circular features in less than 2 days of analysis. More detailed analyses of selected regions were also conducted on mosaics compiled from images in the infrared spectrum (0.8-1.1 micrometers) at 1:1,000,000 scale by several individuals working independently. Comparison of these results helps determine the level of confidence of the interpretations. Further comparison with published geologic and geophysical maps at similar scales helps strengthen this confidence and, furthermore, defines those areas where future field study and exploration is needed.

For presentation at AIME/SME Fall Meeting, September 23-25, 1974, Acapulco, Mexico